PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Gauging Film Width Variation of a Continuous Length of Transparent Birefringent Film of Artificial Organic Material

We, BRITISH CELLOPHANE LIMITED, a British Company, of Bath Road, Bridgwater, Somerset, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention consists in improvements in or relating to apparatus for gauging film width variation of a continuous length of transparent birefringent film of artificial organic material.

In the manufacture commercially of transparent birefringent film of artificial organic material such as, for example, regenerated cellulose, cellulose acetate, cellulose nitrate, polyvinyl alcohol, or rubber hydrochloride, the film is customarily cast in continuous lengths of considerable width, the cast film is dried, and the dried film is collected in the form of mill rolls. Thereafter, to eliminate the edge "bead" which forms during the casting operation, and to convert the wide film into a plurality of films of lesser width, the film coming from a mill roll is generally passed through a slitting machine. For the appropriate adjustment of the slitting knives of the slitting machine, particularly with a view to reducing waste incidental to the elimination of the edge "bead," it is desirable to know beforehand the permissible variation in the width of the film, so that the slitting knives of the slitting machine can be set to sever the edge "bead" from the remainder of the film without at times cutting off with the bead appreciable widths of valuable film.

Film width gauges heretofore employed, of types operating on purely mechanical principles, have proved to be not entirely satisfactory, for the reason in some cases that they do not measure film width accurately irrespectively of the unavoidable side-sway of the travelling film, or for the reason in other cases that they have been so complicated in construction and operation as to be commercially impractical. These deficiencies of existing film width gauges have operated hitherto against their general employment in film manufacture.

A device for indicating the width of an object that is subject to movement in the direction of its width has already been described in British Patent Specification No. 545,140, which comprises a first means for projecting a beam of light past one edge of the object so that a portion of the beam is intercepted by one of the edges, a second means for projecting a beam of light past the opposite edge of the object so that a portion of this beam is intercepted, a light sensitive device arranged to receive the unintercepted portion of one of the beams and a second light sensitive device arranged to receive the unintercepted portion of the other of the beams, means controlled by each of the light sensitive devices for independently moving the beams to new positions to follow changes in the positions of said edges, and means for indicating the algebraic sum of the deviations of the beams from fixed points. This device is suitable for indicating variations in position of the edge and also the width of moving opaque material, such as steel.

The principal object of the present invention is to provide relatively simple and inexpensive apparatus for simply, accurately and continuously gauging width variation of a continuous length of transparent birefringent film as aforesaid, independently of side sway of the travelling length of film, before said film is collected in the form of a mill roll.

According to the present invention, apparatus for gauging film width varia-

[Price 2/-]

tion of a continuous length of transparent birefringent film of artificial organic material, travelling in a substantially fixed path, comprises two identical optical systems operative in conjunction with the respective edge portions of the film, each system comprising a constant uniform light-source, a first light-polarising means for converting light coming from said light-source to plane polarised light, a second light-polarising means disposed to receive polarised light from said first light-polarising means, and set for extinction with said first light polarising means and a photo-electric cell disposed to be energised by light transmitted by said second light-polarising means, said first and second light-polarising means being further disposed to receive therebetween the parts of the travelling film including an edge and the portion closely adjoining the same, and means for measuring collectively the response from both photoelectric cells.

Any variation from a predetermined total response will be a measure of the width variation of the continuous length of film aforesaid, independently of film sway.

Preferably, the response from both photoelectric cells is measured and recorded continuously.

In the case where width variation of a continuous length of transparent birefringent of regenerated cellulose is gauged by means of the apparatus in accordance with the invention, that portion of the plane polarised light of each beam intercepted by said parts of the film is converted into elliptically polarised light, and the total amount of elliptically polarised light is continuously measured, and preferably recorded.

The beams of plane polarised light may be produced by identical optical systems disposed at each side of the continuous length of film in a line parallel to the transverse axis of the web. Each such system may consist of a constant, uniform light source and two separated light-polarising means set to extinction, the parts of the film including the two edges and the parts closely adjoining the same travelling between the separated light-polarising means, for the production of plane polarised light, may suitably be, for example, Nicol prisms of the known type, or light-polarising sheets of the type known under the Registered Trade Mark " Polaroid. "

The foregoing and other features of the invention will be more clearly understood by reference to the following detailed description when taken in conjunction with the accompanying drawing, which is of a diagrammatic character, and in which the Figure illustrates diagrammatically a preferred apparatus in accordance with the invention for gauging film width variation of a continuous length of transparent birefringent film of artificial organic material.

Referring to the accompanying drawing, two identical optical systems are disposed one at each edge of the continuous length of transparent birefringent film of artificial organic material, travelling in a substantially fixed path, said optical systems being so disposed in a line parallel to the transverse axis of the continuous length of film aforesaid. These optical systems consist of constant uniform light sources S and S_2, collimating lenses L_1 and L_2 for directing the light to form broad uniformly illuminated fields, light-polarising means P_1 and P_2, e.g. Nicol prisms or light-polarising sheets of the type known under the Registered Trade Mark " Polaroid," for converting the light coming from the collimating lenses to plane polarised light whose electric vector is at 45° to the direction of travel of the web and to the transverse direction of the film, a second set of light-polarising means P_3 and P_4 set for excitation with P_1 and P_2 respectively, and photoelectric cells C_1 and C_2 positioned to receive any light transmitted by light-polarising means P_3 and P_4. The electric output of cells C_1 and C_2 is measured by any suitable known means (not shown), such as a recording ammeter calibrated to read directly in units of length.

The operation of the arrangement just described is as follows:—

Since light-polarising means P_3 is set for extinction with light-polarising means P_2, no plane polarised light is normally transmitted to photoelectric cells C_1 and C_2, and so long as the beams between P_1 and P_3, and P_2 and P_4, respectively, are not intercepted by the insertion of transparent birefringent material, no response will be obtained from the cells C_1 and C_2. However, in operation the edges of the transparent birefringent film F pass through, and hence intercept, a portion of each beam by interference convert the light in the intercepted portion of the beam from plane polarised light to light of different polarisation (e.g. elliptically polarised light in the case of transparent birefringent regenerated cellulose film), which light passes through polarising means P_3 and P_4 to energise cells C_1 and C_2. The extent to which cells C_1 and C_2 will be energised will depend, of course, upon the amount of light transmitted by polarising means

P_3 and P_4, and other conditions remaining constant, this amount of light will depend, in turn, upon the area of the film intercepting the beams and creating interference. The response of cells C_1 and C_2 is thus a function of the area of the film passing through the beams of plane polarised light, which area is, of course, directly related to the width of the film. The system is calibrated so that a given total response from the cells represents a film of predetermined width. Any deviation from this total will, therefore, represent a variation in the width of the film and, as stated previously, it is desirable that the instrument recording the total response from the photoelectric cells be calibrated to record the variation directly in terms of suitable units of length.

In the course of travel through the casting machine and to the mill roll, the film, on occasion, for one reason or another, tends to sway or weave from one side to the other. However this action, which normally is very limited in extent, has no effect on the accuracy of the measurements made in accordance with the principles hereinabove set forth, for it will be obvious that as one edge portion of the film shifts out of one beam of polarised light, due to film sway, an equal amount of film will move into the other beam of polarised light, whereby the total response from the two photoelectric cells remains unchanged. An increase or decrease in the total photoelectric response therefore truly signifies, in every instance, an actual proportionate increase or decrease in the width of the film.

In the preferred arrangement above described, the response or energy output of each photoelectric cell fluctuates in accordance with the area and intensity of the beam transmitted thereto by the adjacent light-polarising means. In some instances, however, it may be desirable to render the photoelectric cells responsive to fluctuations in intensity only, and this may be accomplished by adding a condensing lens between said second light-polarising means and the photoelectric cell disposed to be energised by light transmitted thereby, and focussing the light to a spot on the cell. Additional modifications, such as the use of colour filters, masks to eliminate stray light and/or to correct the response of the cell to a straight-line relationship, retarding plates, and other applicable optical accessories, are within the purview of this invention.

The apparatus of the present invention provides the possibility of gauging at low cost accurately and continuously width variations of a continuous length of transparent birefringent film of artificial organic material, travelling in a substantially fixed path in, for example, a casting machine or coating tower, whereby the operator is enabled at a glance to determine at what points the slitting knives of the slitting machine should be set to eliminate edge "bead" with a minimum loss of film and to slit the film to best advantage.

In contrast with previous devices for the purpose, an outstanding advantage of the apparatus of the present invention resides in the fact that the film width is gauged thereby independently of the sway or weaving of the film from side to side on the machine, and this desideratum is accomplished without resort to complicated mechanical arrangements which are expensive to manufacture and difficult to maintain in operation.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Apparatus for gauging film width variation of a continuous length of transparent birefringent film of artificial organic material, travelling in a substantially fixed path, which apparatus comprises two identical optical systems operative in conjunction with the respective edge portions of the film, each system comprising a constant uniform light-source, a first light-polarising means for converting light coming from said light-source to plane polarised light, a second light-polarising means disposed to receive polarised light from said first light-polarising means and set for extinction with said first light-polarising means, and a photoelectric cell disposed to be energised by light transmitted by said second light-polarising means, said first and second light-polarising means being further disposed to receive therebetween the parts of the travelling film including an edge and the portion closely adjoining the same, and means for measuring collectively the response from both photoelectric cells.

2. Apparatus as claimed in claim 1, in which means are provided for measuring collectively and recording continuously the response from both photoelectric cells.

3. Apparatus as claimed in claim 1 or claim 2 in which each optical system comprises also a condensing lens between said second light-polarising means and the photoelectric cell disposed to be energised by light transmitted thereby,

whereby light is focussed to a spot on said cell.

4. The combination of a travelling continuous length of transparent birefringent film of artificial organic material, travelling in a substantially fixed path, stationary light-polarising means oppositely disposed at each of the two edges of the travelling length of film for creating at each edge a beam of plane polarised light substantially normal to the surface of the film through part of which beam the respective edge of the film passes, light-polarising means for absorbing that portion of the plane polarised light not intercepted by the travelling film and for transmitting the light transmitted by the film, light-sensitive means comprising photoelectric cells responsive to the light transmitted by the last-named light-polarising means, and means for continuously measuring the summed response of said light-sensitive means.

5. Apparatus for gauging film width variations as claimed in claim 1 and arranged and operating substantially as described herein with reference to the accompanying diagram.

Dated this 30th day of July, 1946.
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111/112, Hatton Garden, London, E.C.1,
Chartered Patent Agents.

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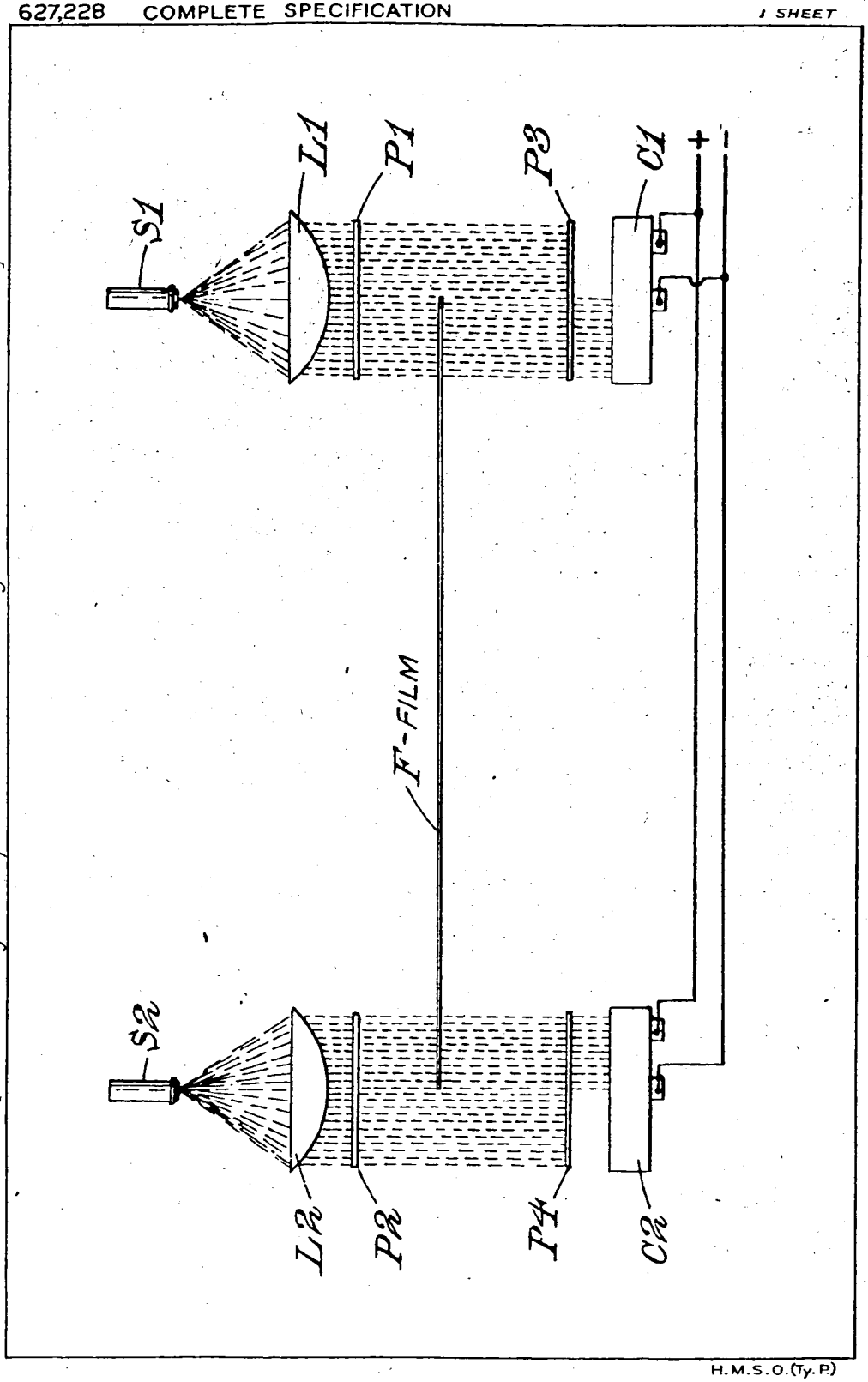
[This Drawing is a reproduction of the Original on a reduced scale.]



H.M.S.O.(Ty.P.)